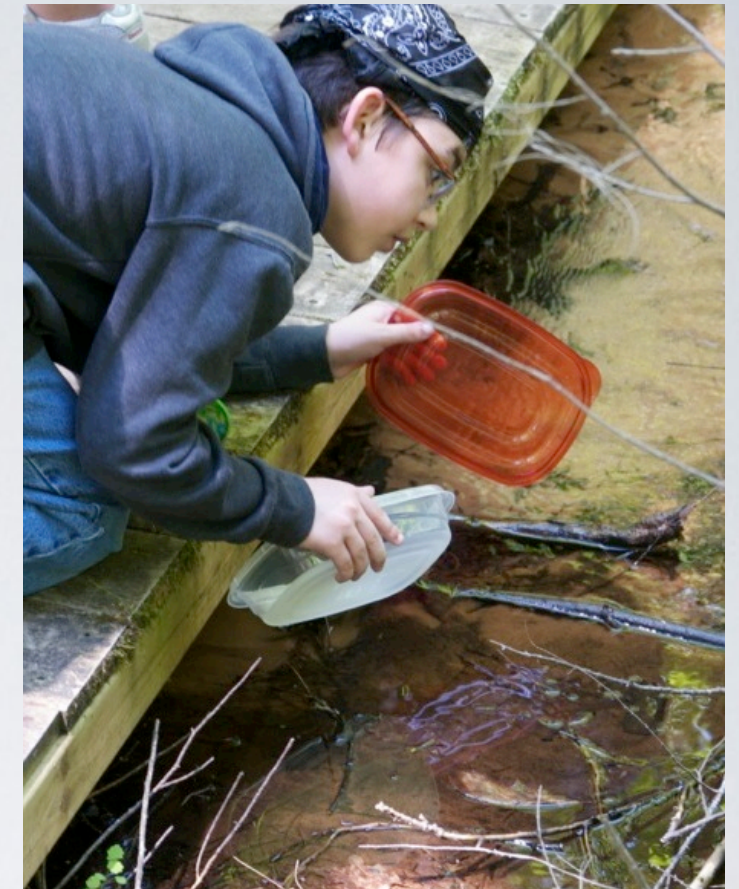
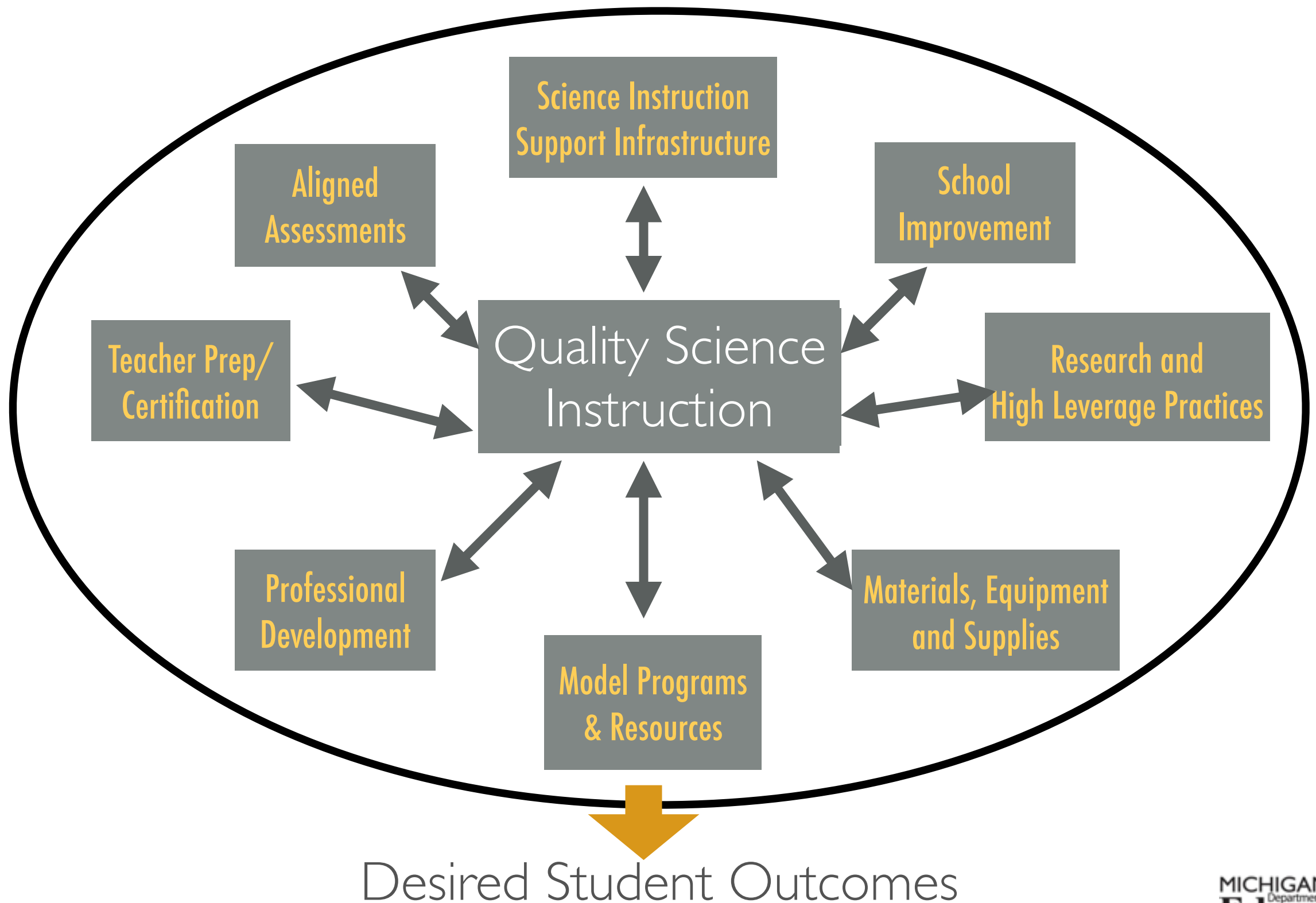


Michigan Science Standards

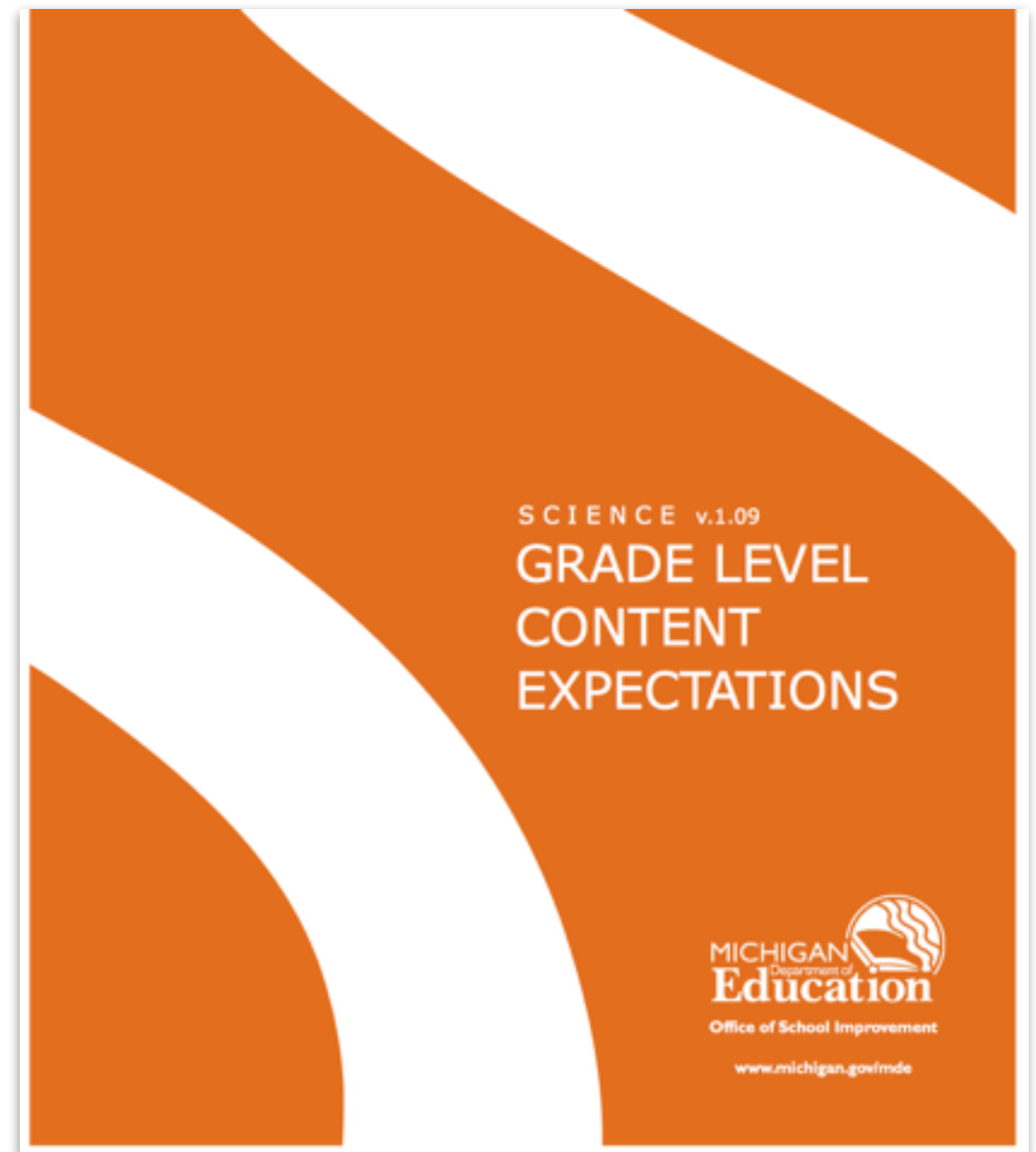


ACHIEVING THE VISION

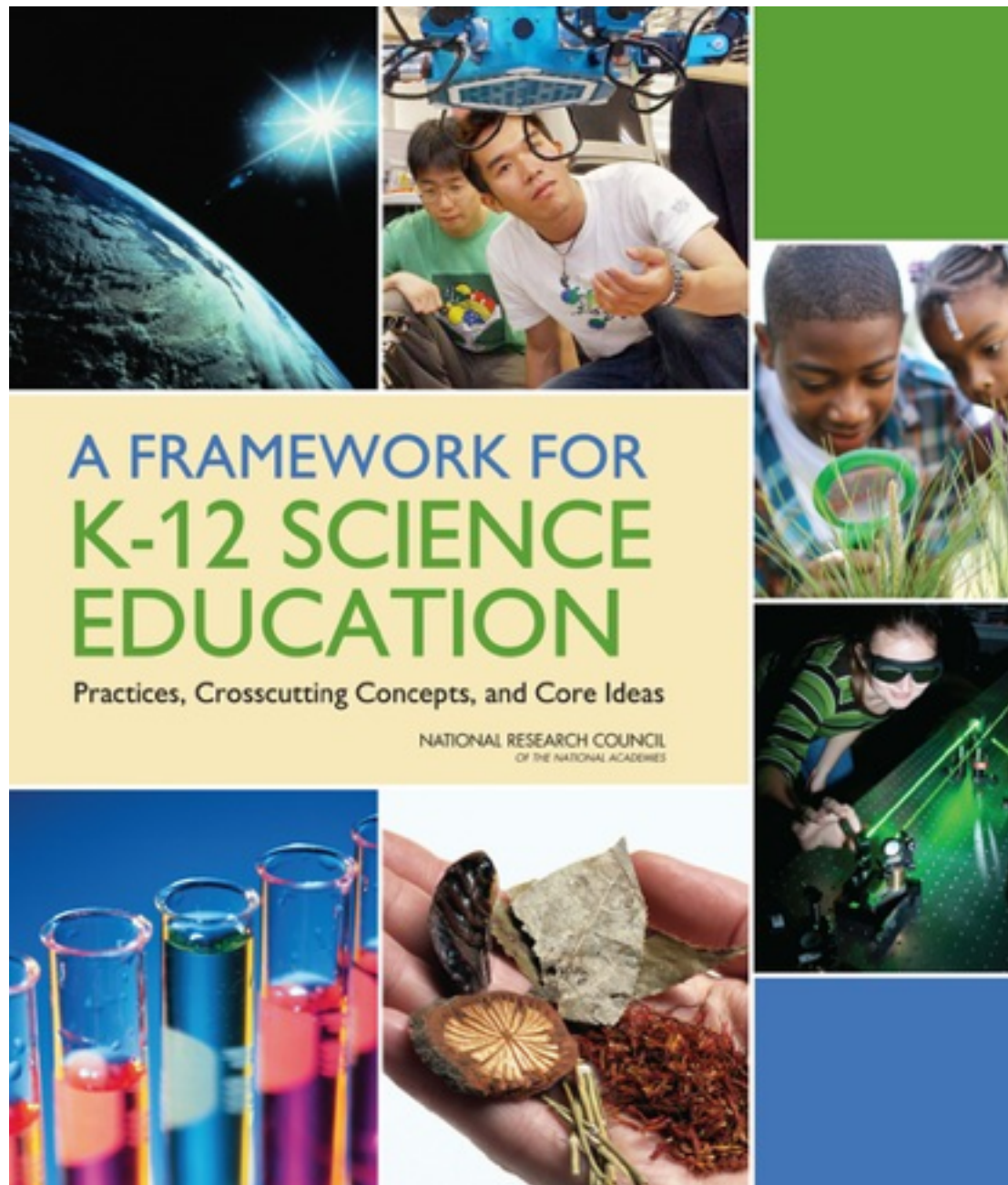


CURRENT STANDARDS

- Approved in 2006
- K-7 Grade Level Content Expectations (GLCEs) and High School Content Expectations (HSCEs)
- Followed by Companion Documents and topic-based mapping tools for support



A RESEARCH-BASED TRANSITION



PRIMARY ISSUES:

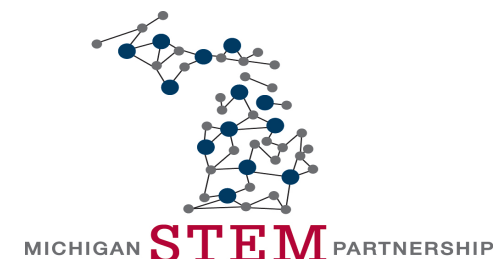
- Incorporation of practices from the field
- No cross-cutting practices or integration
- Lack of understanding of learner needs

LEAD TO TRANSITION:

- Effort to restructure standards based on research findings and current landscape

DEVELOPMENT EFFORT

- Michigan was one of 26 lead states involved in the development effort
- Several parties involved in science education in Michigan became partners in development and implementation
- Since publication, this has become the default resource and focus for Michigan science educators



Asking Questions and Defining Problems

Developing and Using Models

Planning and Carrying Out Investigations

Analyzing and Interpreting Data

Using Mathematics and Computational Thinking

Constructing Explanations and Designing Solutions

Engaging in Argument from Evidence

Obtaining, Evaluating, and Communicating Information

FOUNDATIONAL PRACTICES OF SCIENCE AND ENGINEERING

FOUNDATIONAL
PRACTICES OF
SCIENCE AND
ENGINEERING

Physical Science

Earth Science

Life Science

Patterns

Cause and Effect

Scale, Proportion, and Quantity

Systems and System Models

Energy and Matter

Structure and Function

Stability and Change

Engineering and Design

Cross-disciplinary Integration

Mathematics and Language Arts

Physical Science

Earth Science

Life Science

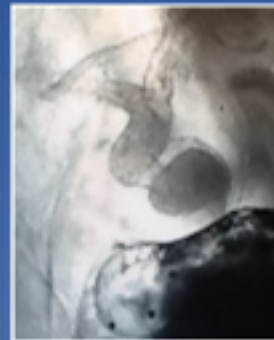
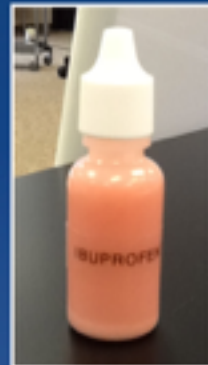
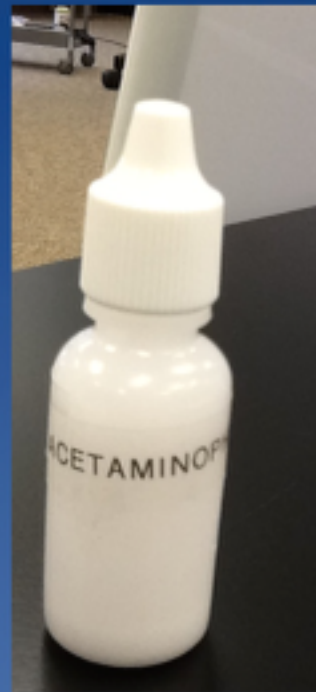


WHEN (AND HOW)
DO WE START?

Question

How do three different types of painkillers affect the heart rate of the xenopus tadpole?

Observation

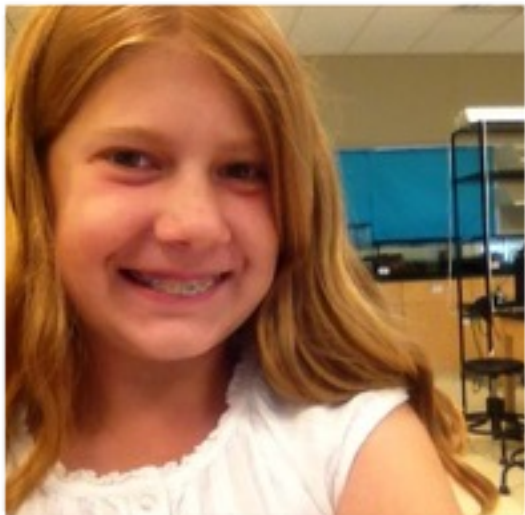


Ibuprofen Data Table

Trials	Culture Water	Ibuprofen	Qualitative Data/Notes
1	126 bpm	102 bpm	Very high heart rate
2	102 bpm	114 bpm	Great visual of heart beating
3	84 bpm	84 bpm	Could see blood flowing, hard to see heart
4	84 bpm	84 bpm	
5	72 bpm	78 bpm	Lower heart rate
6	90 bpm	84 bpm	Could see lungs great
7	90 bpm	90 bpm	
8	84 bpm	90 bpm	Could see blood flowing
9	84 bpm	96 bpm	Great visual of heart
10	90 bpm	90 bpm	No change
Average	90.6	91.2	

WHAT DO WE SEE
FROM STUDENTS?

- Predictions
- Sources of Error
- Confidence in results
- Future questions to investigate



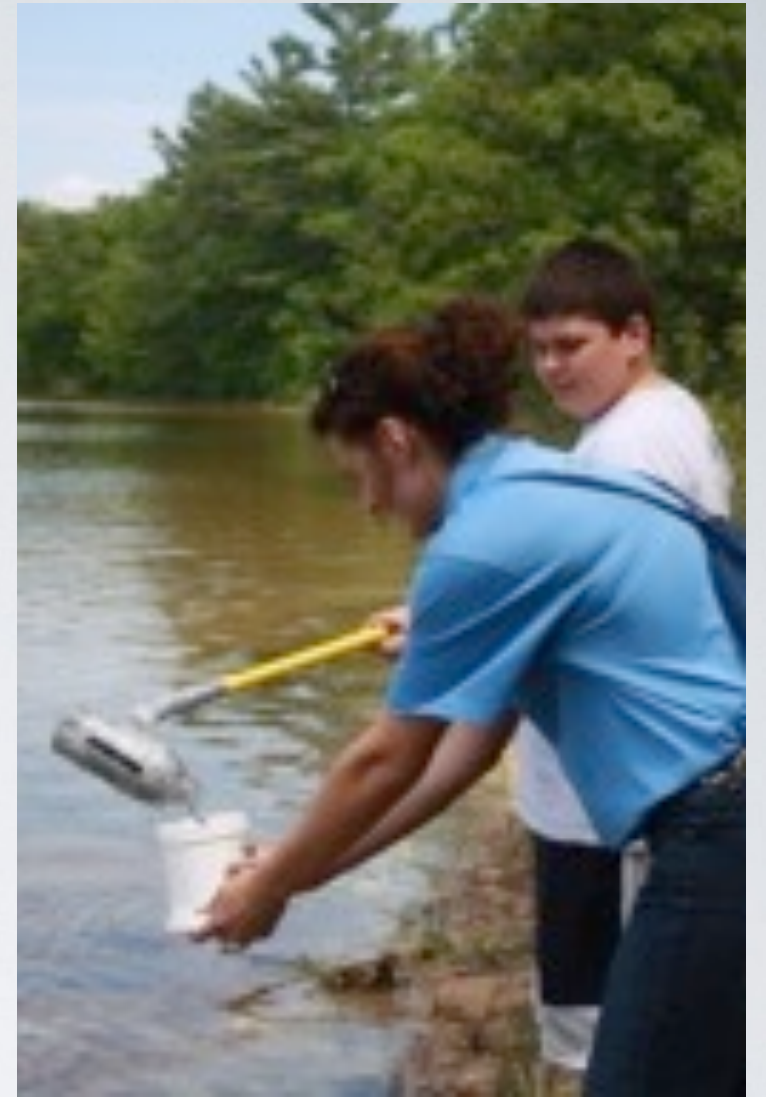
Claim: I claim that when introduced to the xenopus tadpole, these painkillers will most likely make the heart rate go up, or it will stay the same, but rarely go down.

Evidence: Almost all of my trials support my claim; they all either stayed the same, or went up. For the example 24/30 trials either went up or stayed the same, and the average of all the trials is 87.2 in water, and 91.8 when the painkiller is introduced.

Reasoning: I did ten trials for each type of medicine, so my investigation was a fair test, and I looked for all potential sources of error, and if there was one, I restarted, so I am strongly confident in my investigation. I had also known from second hand research that these medicines had no known stimulants or depressants, so it wouldn't make much of a difference.

CONNECTING SCIENTIFIC PRACTICES WITH MATH AND ELA SKILLS

Driving Question:
**What is the water
like in our river?**



HOW DO WE ENGAGE LEARNERS
AND DEEPEN UNDERSTANDING?

Driving Question:
**What is the water
like in our river?**

Where does the
water in our
river come from?

**What happens
when it rains?**

*How does the
water get to the
river?*

*Who depends
on the water?*

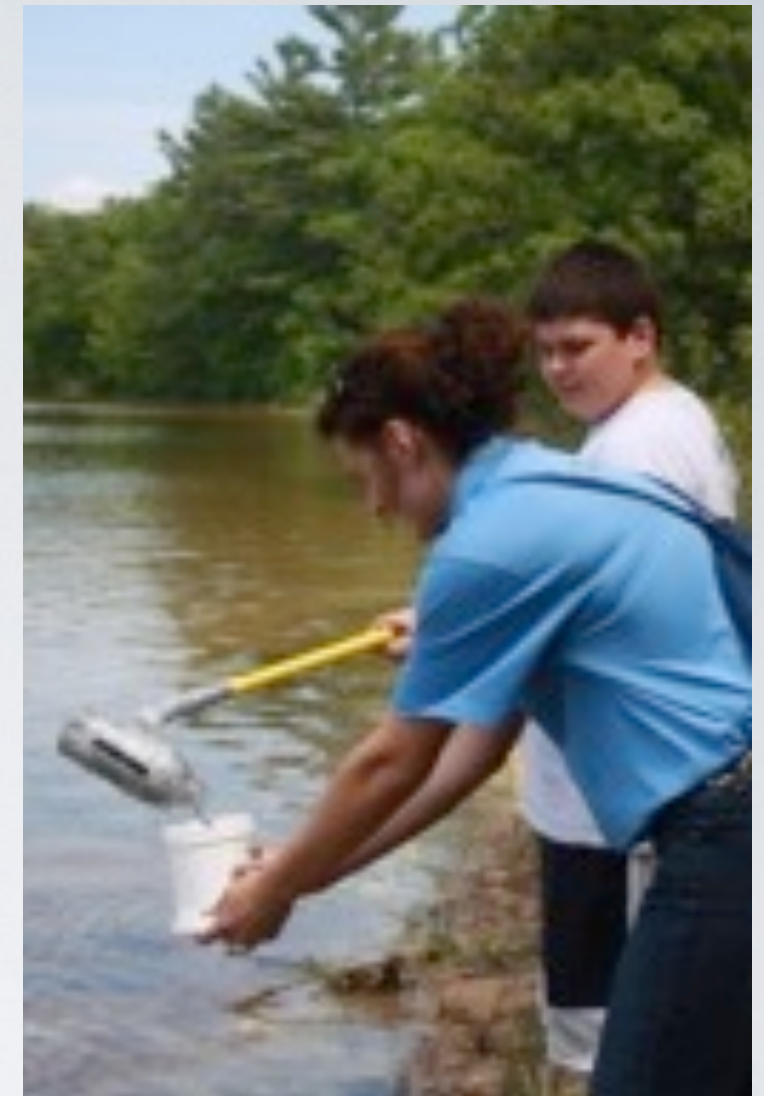
**Is the water
different through
the river?**

What is in the water
in our river?

**What lives in the
river?**

Is our river different
from others?

**Can we drink
the water?**



HOW DO WE ENGAGE LEARNERS
AND DEEPEN UNDERSTANDING?

Standards Comparison: Structure and Properties of Matter

Students who demonstrate understanding can:

Current

- a. **Classify** substances by their chemical properties (flammability, pH, and reactivity).
- b. **Identify** the smallest component that makes up an element.
- c. **Describe** how the elements within the Periodic Table are organized by similar properties into families (highly reactive metals, less reactive metals, highly reactive nonmetals, and some almost completely non-reactive gases).
- d. **Illustrate** the structure of molecules using models or drawings (water, carbon dioxide, table salt).
- e. **Describe** examples of physical and chemical properties of elements and compounds (boiling point, density, color, conductivity, reactivity).

Proposed:

1. **Develop models to describe** the atomic composition of simple molecules and extended structures.
2. **Analyze and interpret data** on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
3. **Gather and make sense of information to describe** that synthetic materials come from natural resources and impact society.
4. **Develop a model that predicts and describes** changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
5. **Develop and use a model to describe** how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
6. **Undertake a design project to construct, test, and modify a device** that either releases or absorbs thermal energy by chemical processes.*

A REVIEW OF STANDARDS...

MDE / Wayne RESA contract
with SRI International:

- External, independent content comparison review
- Michigan Science Standards (GLCE and HSCE) to Next Generation Science Standards

Methodology:

- Crosswalk framework
- Content analysis for similarities and differences



SRI RECOMMENDATIONS AND RATIONALES

Recommendations	Rationales
Michigan should consider the adoption of the NGSS performance expectations in order to improve science education in all grades.	The value added by the adoption of the NGSS includes access to current science concepts that are required to prepare students for college and careers.
The NGSS Science and Engineering Practices and Crosscutting Concepts should be implemented to enhance current science education instruction for grades K-12.	The NGSS Science and Engineering Practices and Crosscutting Concepts are embedded across the NGSS performance expectations and provide coherence across grades and all science disciplines.
The NGSS performance expectations for the Disciplinary Core Ideas in Engineering, Technology and Application of Science contain new content that should be included in science instruction across all grades.	Implementation of the NGSS performance expectations in new content areas such as Engineering, Technology and the Application of Science will prepare students for solving future and current societal problems.
The NGSS performance expectations provide explicit connections to Common Core Mathematics and English Language Arts Standards that should be integrated into science instruction.	The NGSS linkages to the Common Core Standards for Mathematics and English Language Arts connect consistent performance expectations across core content areas.
NGSS Professional Development Resources that support instruction in new content areas are available through participation in the NGSS Network and should be leveraged to support Michigan science teachers.	On-going, high quality professional development that includes current science concepts is essential to improvements in science instruction.

MICHIGAN SCIENCE STANDARDS

For Adoption:

- **Student Performance Expectations** (and relevant NGSS coding), including Michigan specific expectations where appropriate
- **Front matter describing**
Crosscutting Concepts (organizational frame),
Science and Engineering Practices (integrated into performance expectations), and
Disciplinary Core Ideas

Not for Adoption

- Guidance Materials on Instruction and Assessment
- Ancillary Materials (Appendices, Models, Crosswalks, etc.)

WHY?:

- Offer greater flexibility for local implementation in Michigan's school districts and public school academies


PROPOSED SCIENCE STANDARDS & GUIDANCE

4th Grade

I

Earth's Systems: Processes that Shape the Earth


4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. **

 4-ESS1-1 MI Identify evidence from patterns in rock formations and fossils in rock layers to support possible explanations of Michigan's geological changes over time.

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation**

4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.

4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. * **

 4-ESS3-2 MI Generate and compare multiple solutions to reduce the impacts of natural Earth processes on Michigan's people and places.

Engineering Design

3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

* - Integrates traditional science content with engineering.



- Includes a Michigan specific performance expectation.

** - Allow for local, regional, or Michigan specific contexts or examples in teaching and assessment.

I. Organized by grade level or band and content strand


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1

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Page 14 of 29

1. Organized by grade level or band and content strand
2. Performance expectations include coding, and MI-specific alternatives

2

PROPOSED SCIENCE STANDARDS & GUIDANCE

4th Grade

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4-ESS2-1 Make observations and/or measurements to provide evidence of the effects

4-ESS2-2

1. Structure, Function, and Information Processing

1. Structure, Function, and Information Processing

Students who demonstrate understanding can:

4-ESS3-2

1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]

1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. [Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]

1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.] [Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1-LS3-1)
- Use materials to design a device that solves a specific problem or a solution to a specific problem. (1-LS1-1)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in K-2 builds on prior experiences and uses observations and tools to communicate new information.

- Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. (1-LS1-2)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Scientists look for patterns and order when making observations about the world. (1-LS1-2)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels: **K-ETS1.A** (1-LS1-1); **3-LS2.D** (1-LS1-2); **3-LS3.A** (1-LS3-1); **3-LS3.B** (1-LS3-1); **4-LS1.A** (1-LS1-1); **4-LS1.D** (1-LS1-1); **4-ETS1.A** (1-LS1-1)

Common Core State Standards Connections:

ELA/Literacy--

RI.1.1 Ask and answer questions about key details in a text. (1-LS1-2); (1-LS3-1)

RI.1.2 Identify the main topic and restate key details of a text. (1-LS1-2)

RI.1.10 With prompting and support, read informational texts appropriately complex for grade. (1-LS1-2)

W.1.7 Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-LS1-1); (1-LS3-1)

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-LS3-1)

Mathematics--

MP.2 Reason abstractly and quantitatively. (1-LS3-1)

MP.5 Use appropriate tools strategically. (1-LS3-1)

1.NBT.B.3 Compare two two-digit numbers based on the meanings of the tens and one digits, recording the results of comparisons with the symbols $>$, $=$, and $<$. (1-LS1-2)

1.NBT.C.4 Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. (1-LS1-2)

1.NBT.C.5 Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. (1-LS1-2)

1.NBT.C.6 Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. (1-LS1-2)

1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object. (1-LS3-1)

* - Integrates

** - Allow for

2

3

1. Organized by grade level or band and content strand
2. Performance expectations include coding, and MI-specific alternatives
3. Guidance organized in same manner, but includes relevant Science and Engineering Practice, Disciplinary Core Ideas, and Crosscutting Concepts)

* - Integrates
**- Allow for

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4-ESS2-1	Make observations and/or measurements to provide evidence of the effects
4-ESS2-2	
4-ESS3-2	
3-5-ETS1-1	
3-5-ETS1-2	
3-5-ETS1-3	
* - Integrates **- Allow for	

1. Organized by grade level or band and content strand
2. Performance expectations include coding, and MI-specific alternatives
3. Guidance organized in same manner, but includes relevant Science and Engineering Practice, Disciplinary Core Ideas, and Crosscutting Concepts
4. Guidance also includes relevant assessment boundaries, contexts, and related standards

NEXT STEPS - ASSESSMENT

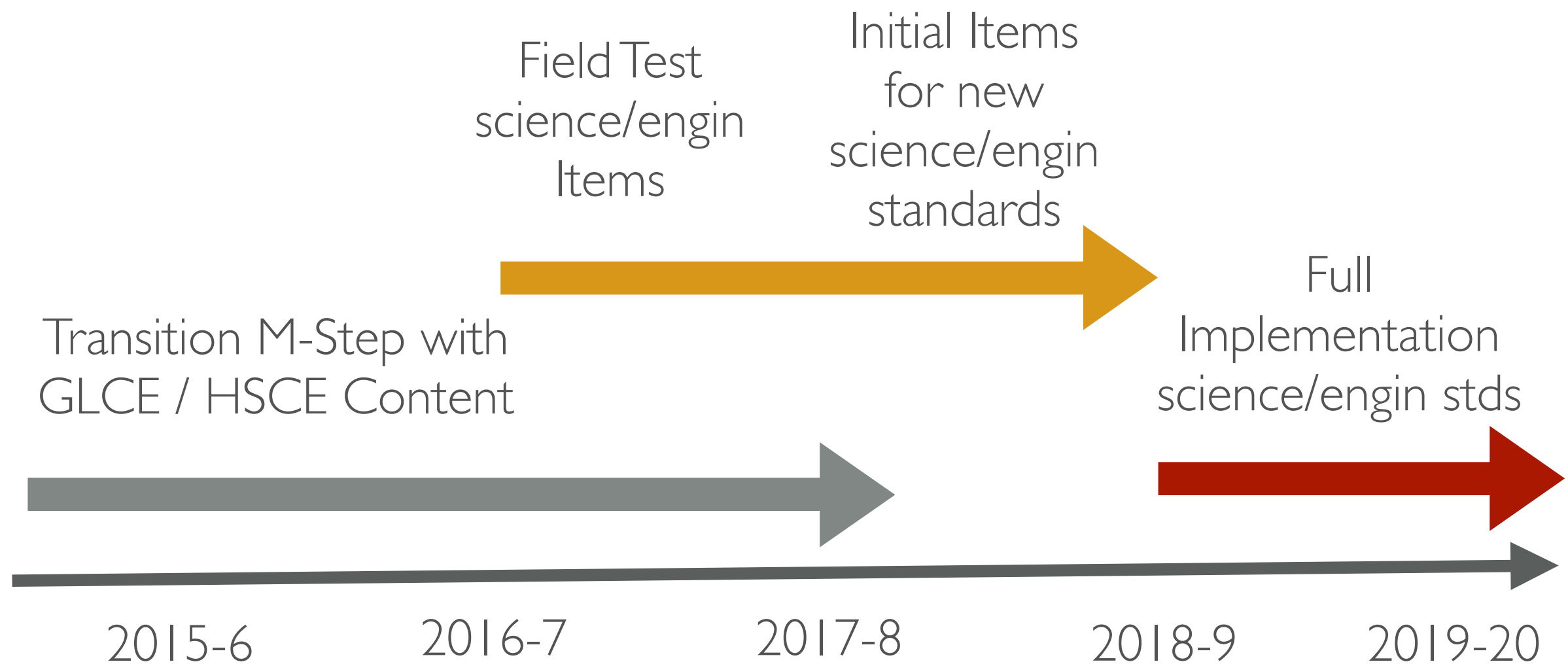


State and Local Assessments



Formative Assessments

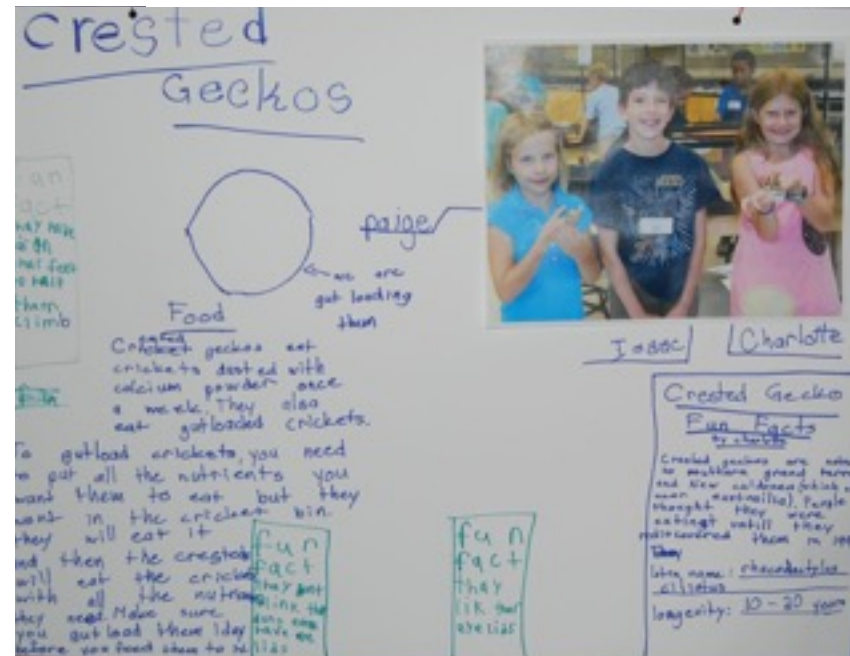
SCIENCE ASSESSMENT TIMELINE



CLASSROOM AND SCHOOL ASSESSMENTS FOR SCIENCE



Common local assessments



Analysis of student artifacts



Performance assessment

NEXT STEPS - SCHOOL POLICY



Resources for Learning



Instructional Practice

TRANSITION TIMELINE

